

PRELIMINARY DATA SUMMARY

May 1989

U.S. Army Engineer Waterways Experiment Station
Coastal Engineering Research Center
Field Research Facility
Duck, North Carolina

PRELIMINARY DATA SUMMARY

CERC Field Research Facility Duck, North Carolina

This report provides a summary of basic oceanographic, meteorological and bottom profile data for the month. The data were obtained as part of the Measurements and Analysis work units at the U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's Field Research Facility (FRF) in Duck, North Carolina. The FRF staff collected and analyzed these data. These summaries are intended to make the data readily available to all FRF users, and comments on their content and usefulness are invited.

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PART I: INTRODUCTION

The U.S. Army Engineer Waterways Experiment Station, Coastal Engineering Research Center's (CERC's) Field Research Facility (FRF) is located on the Outer Banks of North Carolina, near the village of Duck (Figure 1).

The FRF research program provides a means for obtaining high-quality field data, particularly during storms, in support of the U.S. Army Corps of Engineers' coastal engineering research missions. The research pier is a reinforced concrete structure supported on 0.9-m-diam steel piles spaced 12.2 m apart along the pier's length and 4.6 m apart across the width. The pier deck is 6.1 m wide and extends from behind the duneline to about the 6-m water depth contour at a height of 7.6 m above the National Geodetic Vertical Datum (NGVD). In addition, a main building contains offices, an instrument repair shop, and a data acquisition room.

One of the responsibilities of the FRF research program is the collection, analysis and dissemination of data on local oceanographic and meteorological conditions. Bottom profiles along both sides of the pier and periodic bathymetric surveys are also performed.

This summary is intended to provide basic data as soon as possible after they are obtained. Questions and/or comments concerning the data may be directed to Mr. Michael W. Leffler at (919) 261-3511.

Part II presents the meteorological data; Parts III through VI present oceanographic data; Part VII presents nearshore profiles and bathymetry; and Part VIII, if included, documents special events that occurred at the FRF during the month.

Table 1 is a list of instruments used, their operational status during the month, and the data collection status. Figure 2 identifies the location of the instruments. The water depths at the wave gages and current meters vary and may be determined from information contained in Figure 7. Other installation information is contained in Table 1.

Times given in the report, unless otherwise specified, are referenced to eastern standard time (EST).

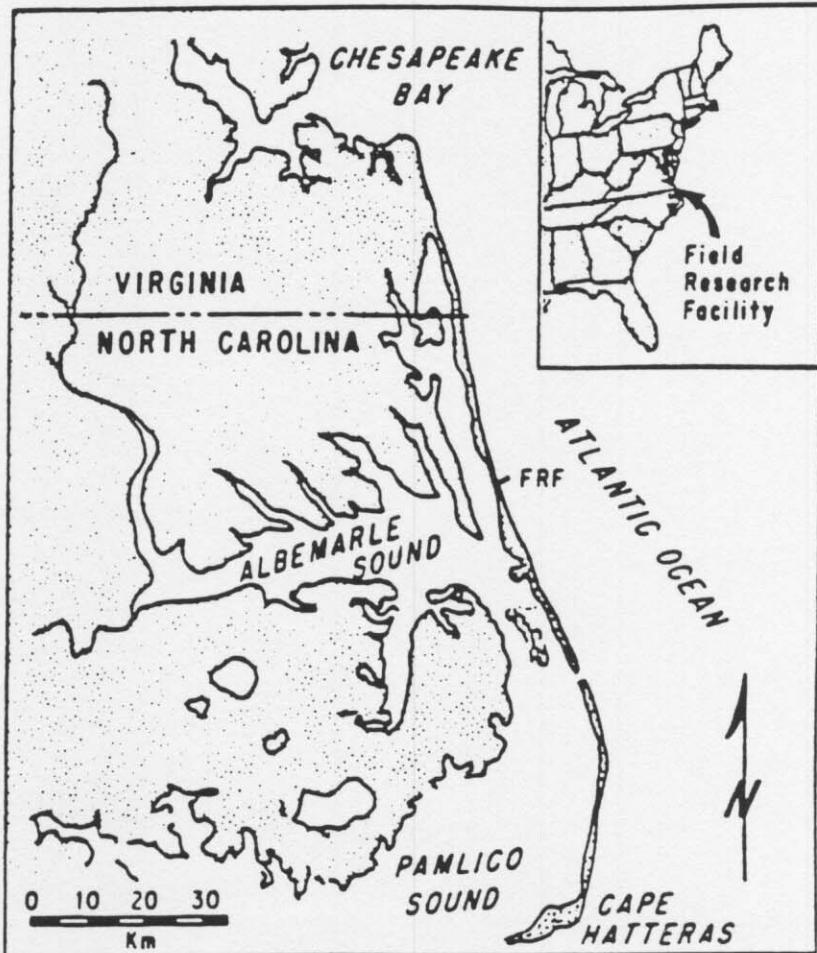


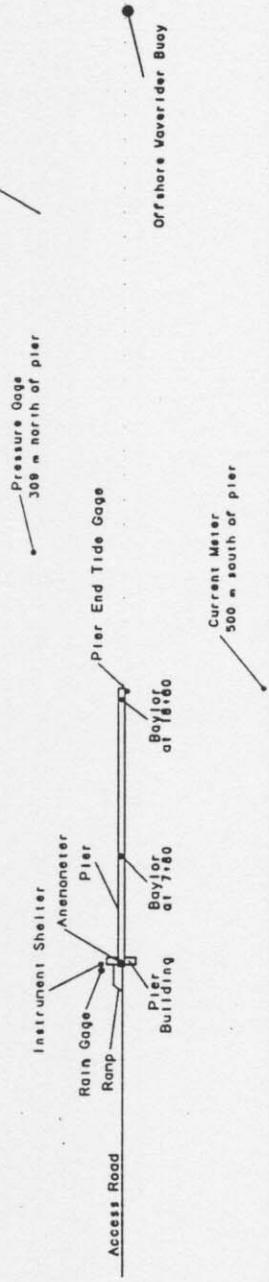
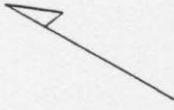
Figure 1. FRF Location Map

Table 1: Instrument Status/Data Availability

MAY 1989

Gage Status	Daily Observation	Analog Record	Data Collected
Operational = *	Complete = *	Complete = *	All = *
Partial = /	Partial = /	Partial = /	Partial = /
Non-Operational = -	None = -	None = -	None = -

Pier Building at 0+40 10 100
 Anemometer at 0+70
 12 inch Rain Gage at 0+30
 Instrument Shelter at 0+40



CURRI TUCK SOUND

ATLANTIC OCEAN

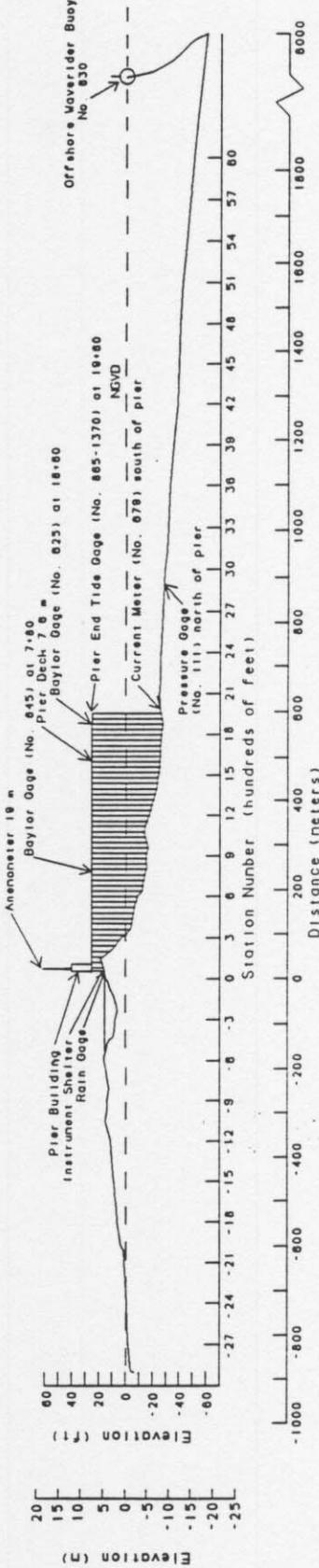


Figure 2. Instrument locations at FRF (all elevations from NGVD, all distances from FRF baseline).

PART II: METEOROLOGICAL DATA

A variety of instruments have been installed at the FRF (Figure 2) to monitor the meteorological conditions. The data presented in Table 2 are collected and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750. For each instrument identified in Table 1 as having analog outputs, chart records are obtained, a log is maintained and the records are stored for future reference.

Winds were measured on top of the laboratory building at an elevation of 19 m (Figure 2) using a Weather Measure Skyvane anemometer.

Monthly resultant wind speeds and directions are determined by vector averaging the data. Temperature and atmospheric pressure means are the average of the values presented for the month. Total precipitation is the sum for the month.

The following may be useful for converting the data in Table 2 to other frequently used units of measurement:

1. Millimeters (mm) to inches (in.) -
 $mm \times .03937 = in.$
2. Millibars (mb) to inches of mercury (in. Hg) -
 $mb \times 0.02953 = in. Hg$
3. Degrees Celsius (C) to degrees Fahrenheit (F) -
 $(C \times 9/5) + 32 = F$
4. Meters per second (m/s) to knots (kn) -
 $m/s \times 1.943 = kn$

Table 2: Meteorological Data

May 1989

Day	Hour	Wind Speed m/sec	Wind Direction deg TN	Temperature deg C	Atm Pressure mb	Precipitation mm
1	100	5	78	15.4	1016.2	0
	700	5	133	17.3	1014.8	6
	1300	6	179	19.4	1011.4	0
	1900	7	179	22.9	1009.8	0
2	100	8	179	22.5	1005.4	0
	700	8	179	21.6	1003.0	24
	1300	2	48	17.5	1006.0	12
	1900	7	104	20.8	1008.4	0
3	100	3	2	14.0	1011.8	0
	700	5	346	14.3	1015.5	0
	1300	0		15.8	1015.9	0
	1900	4	75	13.8	1017.2	0
4	100	4	288	15.0	1018.6	0
	700	4	26	15.1	1021.6	0
	1300	5	84	17.9	1021.6	0
	1900	7	99	14.6	1020.6	0
5	100	4	119	14.8	1019.2	0
	700	6	151	17.8	1017.5	0
	1300	9	166	22.5	1014.8	0
	1900	8	166	21.1	1011.4	0
6	100	12	198	18.7	1008.7	0
	700	5	225	18.4	1010.4	0
	1300	3	79	19.6	1008.1	0
	1900	8	271	16.4	1008.4	0
7	100	8	286	14.3	1009.8	0
	700	9	281	11.6	1010.8	0
	1300	8	272	15.4	1009.8	0
	1900	7	276	8.5	1012.1	0
8	100	6	282	9.1	1014.2	0
	700	5	255	12.1	1015.5	0
	1300	7	239	16.5	1014.5	0
	1900	5	243	16.7	1015.5	0
9	100	4	212	14.4	1015.9	0
	700	3	209	16.1	1017.2	0
	1300	6	114	17.7	1016.5	0
	1900	5	150	16.1	1012.5	0
10	100	7	122	15.6	1008.1	6
	700	6	195	18.8	1003.3	36
	1300	3	308	17.6	1002.3	0
	1900	5	245	16.9	1003.7	0
11	100	4	292	14.7	1003.7	0
	700	4	360	14.1	1005.4	0
	1300	3	21	16.0	1005.7	0
	1900	3	119	14.4	1007.4	0
12	100	1	343	11.7	1007.4	0
	700	3	263	14.5	1008.7	0
	1300	5	239	18.4	1009.1	0
	1900	7	108	14.8	1010.4	0
13	100	6	314	11.7	1011.8	4
	700	2	356	15.2	1013.5	0
	1300	4	82	19.6	1013.8	0
	1900	6	98	16.7	1014.2	0
14	100	3	183	16.9	1014.2	0
	700	4	264	18.1	1015.9	0
	1300	6	202	20.0	1015.9	0
	1900	3	158	17.4	1014.8	0
15	100	3	146	16.0	1013.5	0
	700	1	70	16.1	1013.1	0
	1300	6	85	18.8	1010.4	7
	1900	2	91	16.7	1008.4	0
16	100	2	66	16.1	1006.4	3
	700	4	273	17.7	1006.7	0
	1300	6	231	20.9	1006.7	0
	1900	7	281	17.9	1007.4	0

(Continued)

(Sheet 1 of 2)

Table 2: Meteorological Data

May 1989

Day	Hour	Wind	Wind	Temperature	Atm	Precipitation
		Speed m/sec	Direction deg TN	deg C	mb	mm
17	100	9	286	16.6	1006.7	0
	700	8	287	16.2	1008.7	0
	1300			17.9	1012.1	0
	1900	11	352	15.9	1015.2	0
	100	5	286	15.3	1015.5	0
18	700	8	291	18.2	1017.2	0
	1300	8	349	19.1	1018.2	0
	1900	8	1	16.5	1019.2	0
	100	7	334	16.1	1018.9	0
19	700	10	352	17.1	1019.6	0
	1300	8	347	17.9	1019.9	0
	1900	6	331	16.9	1017.9	0
	100	4	329	15.6	1015.9	0
20	700	3	357	17.0	1016.2	0
	1300	2	323	20.0	1016.2	0
	1900	4	73	17.9	1012.5	0
	100	3	163	18.8	1012.1	0
21	700	3	158	20.1	1012.5	0
	1300	5	124	23.4	1011.8	0
	1900	4	153	23.5	1010.8	0
	100	2	70	19.0	1012.8	0
22	700	5	353	18.7	1013.5	0
	1300			23.6	1013.8	0
	1900	4	80	20.3	1012.8	0
	100	3	159	21.9	1011.4	0
23	700	4	158	23.3	1010.1	0
	1300	9	122	21.4	1006.7	0
	1900	4	129	19.4	1004.3	0
	100	8	217	20.5	1003.3	0
24	700	9	223	19.1	1006.4	0
	1300	7	215	23.0	1007.0	0
	1900	3	184	22.1	1008.4	0
	100	4	240	20.4	1009.8	0
25	700	2	85	21.8	1013.1	0
	1300	6	113	25.1	1012.8	0
	1900	5	146	24.2	1012.1	0
	100	6	170	22.6	1012.5	0
26	700	5	166	24.1	1013.5	0
	1300	5	190	30.3	1012.1	0
	1900	5	171	26.3	1012.1	0
	100	6	180	24.3	1012.8	0
27	700	6	189	24.8	1012.1	0
	1300	6	209	29.7	1010.8	0
	1900	5	45	17.9	1014.8	0
	100	5	317	17.4	1017.5	0
28	700	11	358	17.8	1021.9	0
	1300	9	353	18.2	1023.3	0
	1900	5	30	16.3	1023.0	0
	100	5	73	15.8	1023.6	0
29	700	4	31	18.7	1025.0	0
	1300	6	62	21.1	1024.0	0
	1900	6	102	19.1	1023.0	0
	100	4	159	19.7	1022.6	0
30	700	5	178	21.7	1023.6	0
	1300	6	157	26.4	1020.9	0
	1900	6	162	22.8	1020.3	0
	100	6	184	21.6	1019.9	0
31	700	8	204	22.5	1020.6	0
	1300	5	205	29.6	1018.9	0
	1900	7	178	26.3	1017.2	0
			Resultant	Mean	Mean	Total
	2	197		18.5	1013.3	98

(Sheet 2 of 2)

PART III: WAVE DATA

Wave data are collected from two Baylor staff gages (Gages 625 and 645), a pressure wave gage (Gage 111) and a Waverider buoy (Gage 630) as shown in Table 1 and Figure 2. The data are collected, analyzed, and stored on magnetic tape using a Digital Equipment Corporation VAX 11/750 programmed to sample the wave gages every 6 hr (more frequently during storms) beginning at 0100, 0700, 1300, and 1900 EST. The sampling rate is two times per second for four contiguous 34-min records.

Wave height H_{mo} is an energy-based statistic equal to four times the standard deviation of the sea surface elevations. Wave height reported from the pressure gage has been compensated for hydrodynamic attenuation using linear wave theory. Wave period is identified from the computation of a variance (energy) spectrum with 60 deg of freedom calculated from a 34-min record. Peak wave period T_p is defined as the period associated with the maximum energy in the spectrum. When this analysis is complete, the data are written to magnetic tape.

Table 3 presents the wave heights and periods for each wave record obtained at 6 hr intervals during the month. The monthly means and standard deviations from the means shown in Table 3 are average values computed from this data. Figure 3 is a time history of all H_{mo} and T_p values obtained for all gages.

Differences in wave periods between wave gages (Table 3 and Figure 3) may be the result of wave breaking, wave reformation, or the presence of multiple wave trains containing nearly equal energy.

Table 3: Wave Data

May 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80	Hmo,m T,sec	Baylor at 18+60	Hmo,m T,sec	Pressure Gage	Hmo,m T,sec	Offshr Wvrdr	Hmo,m T,sec
1	0100	0.37	4.92	0.42	5.22	0.45	4.92	0.51	5.02
	0700	0.26	4.74	0.35	8.53	0.38	8.00	0.44	4.74
	1300	0.28	4.57	0.39	8.53	0.38	8.53	0.46	4.74
	1900	0.37	5.12	0.53	6.56	0.57	6.56	0.81	6.24
2	0100	0.44	5.45	0.57	2.61	0.54	3.51	0.95	4.00
	0700	0.48	7.53	0.63	7.76	0.75	7.53	*	
	1300	0.42	3.12	0.57	7.53	0.58	7.31	0.81	7.11
	1900	0.41	7.31	0.58	7.31	0.65	6.09	0.85	7.31
3	0100	0.30	7.53	0.46	7.31	0.52	7.53	0.68	7.31
	0700	0.23	7.53	0.37	8.00	0.39	7.31	0.49	7.53
	1300	0.30	3.41	0.45	8.26	0.47	8.53	*	
	1900	0.26	15.06	0.40	7.31	0.42	6.56	0.54	7.53
4	0100	0.24	14.22	0.39	13.47	0.38	6.40	0.47	7.53
	0700	0.22	13.47	0.41	13.47	0.45	13.47	0.45	13.47
	1300	0.32	2.13	0.42	6.40	0.48	6.56	0.52	6.92
	1900	0.41	3.41	0.60	3.46	0.46	3.51	0.59	3.51
5	0100	0.35	12.80	0.42	12.80	0.40	12.80	0.48	12.80
	0700	0.33	12.80	0.44	12.80	0.44	12.80	0.50	12.80
	1300	0.71	4.74	0.77	4.83	0.89	3.61	0.93	5.22
	1900	0.65	5.69	0.83	6.09	0.87	5.95	1.12	5.57
6	0100	0.85	4.74	0.95	6.40	1.13	6.56	1.40	6.40
	0700	0.51	6.92	0.75	6.92	0.90	7.11	1.14	6.56
	1300	0.53	4.66	0.69	7.31	0.81	7.31	0.87	7.31
	1900	0.65	5.82	0.71	6.74	0.75	7.53	0.99	6.92
7	0100	0.42	7.31	0.49	7.76	0.57	7.76	0.67	6.92
	0700	0.32	11.64	0.51	11.13	0.50	7.31	0.81	7.76
	1300	0.28	10.67	0.44	10.67	0.52	8.26	0.60	7.76
	1900	0.25	11.13	0.43	7.76	0.45	11.13	0.63	7.76
8	0100	0.22	10.24	0.38	10.67	0.41	10.24	0.49	10.67
	0700	0.22	10.24	0.38	9.85	0.46	10.67	0.49	8.26
	1300	0.22	10.67	0.42	10.67	0.45	10.67	0.48	8.26
	1900	0.23	9.85	0.44	9.85	0.47	9.85	0.46	9.85
9	0100	0.24	10.24	0.43	9.85	0.47	10.67	0.44	8.53
	0700	0.23	10.24	0.41	7.76	0.46	10.24	0.46	8.00
	1300	0.27	10.67	0.44	11.13	0.47	10.67	0.48	8.53
	1900	0.30	10.24	0.47	7.31	0.49	7.11	0.53	7.53
10	0100	0.40	3.71	0.58	6.56	0.64	7.11	0.75	6.92
	0700	0.59	6.92	0.83	7.53	0.87	7.31	1.06	7.53
	1300	0.55	8.00	1.04	7.76	*		1.12	8.00
	1900	0.52	8.26	0.77	7.31	*		0.99	7.11
11	0100	0.46	11.13	0.63	8.26	*		0.80	7.53
	0700	0.46	9.48	0.66	10.24	*		0.74	7.53
	1300	0.52	8.53	0.72	8.00	*		0.85	7.76
	1900	0.52	9.85	0.71	9.48	*		0.87	8.26
12	0100	0.49	8.00	0.65	8.26	*		0.68	8.26
	0700	0.41	7.31	0.54	7.31	*		0.62	7.11
	1300	0.35	9.85	0.54	9.48	*		0.61	7.31
	1900	0.44	2.61	0.61	9.14	*		0.59	7.31
13	0100	0.39	8.53	0.52	9.48	0.45	9.85	0.63	9.85
	0700	0.34	9.85	0.50	11.13	0.54	10.67	0.51	10.24
	1300	0.35	10.24	0.56	10.24	0.60	10.67	0.56	10.67
	1900	0.50	10.24	0.65	11.13	0.61	11.13	0.67	11.64
14	0100	0.34	10.24	0.61	11.13	0.58	10.67	0.66	10.67
	0700	0.34	10.24	0.56	9.85	0.62	10.24	0.58	9.85
	1300	0.36	9.85	0.54	9.48	0.58	9.48	0.75	9.48
	1900	0.32	10.67	0.45	9.85	0.47	10.24	0.56	10.24
15	0100	0.25	8.83	0.41	8.83	0.44	10.24	0.51	9.48
	0700	0.28	4.83	0.43	10.24	0.50	9.85	0.52	8.53
	1300	0.48	4.92	0.59	5.12	0.55	4.92	0.67	5.22
	1900	0.30	5.45	0.47	9.14	0.47	7.31	0.56	5.02
16	0100	0.32	5.22	0.46	9.14	0.51	8.26	0.58	5.45
	0700	0.31	5.33	0.44	9.14	0.45	5.33	0.55	5.22
	1300	0.23	16.00	0.36	16.00	0.41	16.00	0.49	6.74
	1900	0.26	16.00	0.38	15.06	0.38	15.06	0.54	6.09

* Electronic problems

(Continued)

(Sheet 1 of 2)

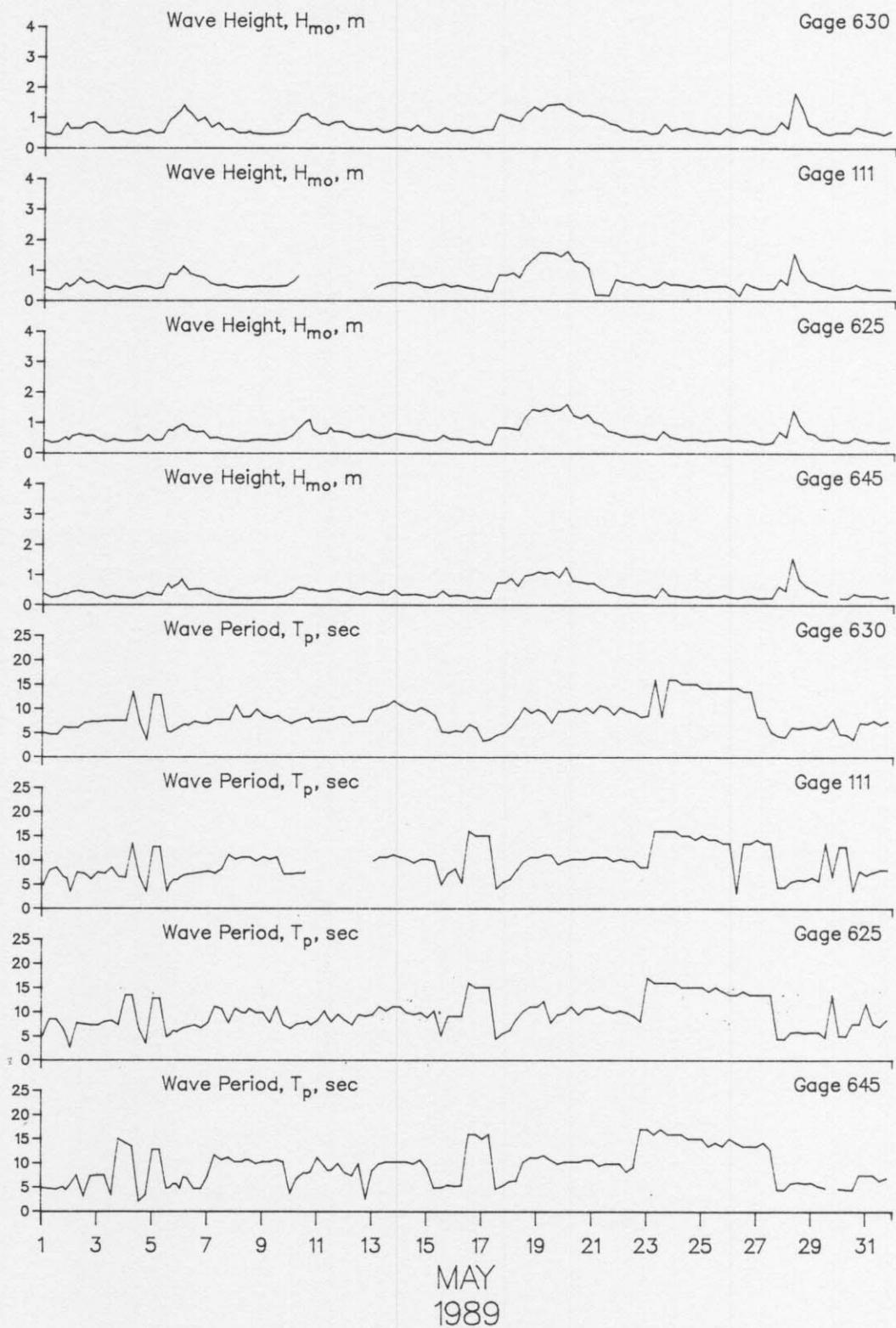
Table 3: Wave Data

May 1989

Day	Hour	645		625		111		630	
		Baylor at 7+80 Hmo,m	T,sec	Baylor at 18+60 Hmo,m	T,sec	Pressure Gage Hmo,m	T,sec	Offshr Wvrdr Hmo,m	T,sec
17	0100	0.22	15.06	0.29	15.06	0.33	15.06	0.61	3.37
	0700	0.23	16.00	0.28	15.06	0.32	15.06	0.61	3.66
	1300	0.75	4.66	0.85	4.41	0.87	4.13	1.11	4.57
	1900	0.75	5.33	0.85	5.57	0.86	5.45	1.01	5.02
18	0100	0.90	6.24	0.82	6.24	0.93	6.09	0.95	6.24
	0700	0.64	6.40	0.77	8.53	0.78	8.00	0.88	8.00
	1300	0.98	10.24	1.21	10.24	1.19	9.85	1.18	10.24
	1900	1.02	11.13	1.45	11.13	1.40	10.67	1.36	9.14
19	0100	1.12	11.13	1.39	11.13	1.60	10.67	1.23	9.85
	0700	1.06	11.64	1.48	12.19	1.60	11.13	1.42	9.14
	1300	1.11	10.67	1.39	7.76	1.58	11.13	1.44	7.11
	1900	0.92	9.85	1.44	9.48	1.46	9.14	1.46	9.48
20	0100	1.26	10.24	1.61	9.85	1.63	9.85	1.28	9.48
	0700	0.80	10.24	1.23	11.13	1.31	10.24	1.20	9.85
	1300	0.77	10.24	1.15	9.48	1.27	10.24	1.05	9.48
	1900	0.72	10.67	1.26	10.67	1.08	10.24	1.06	10.24
21	0100	*	1.02	10.67	*	*	1.01	9.14	
	0700	0.56	9.48	0.94	11.13	*	0.93	10.67	
	1300	0.44	9.85	0.72	10.24	*	0.80	10.24	
	1900	0.41	9.85	0.68	9.85	0.70	9.85	0.75	8.83
22	0100	0.34	9.85	0.59	10.24	0.62	10.24	0.60	10.24
	0700	0.33	8.26	0.53	9.85	0.60	9.85	0.55	9.48
	1300	0.30	9.14	0.54	9.14	0.52	9.85	0.54	9.14
	1900	0.31	17.07	0.55	8.00	0.55	8.53	0.54	8.26
23	0100	0.32	17.07	0.48	17.07	0.45	8.53	0.46	8.53
	0700	0.25	16.00	0.44	16.00	0.47	16.00	0.49	16.00
	1300	0.57	17.07	0.72	16.00	0.63	16.00	0.79	8.26
	1900	0.32	16.00	0.54	16.00	0.54	16.00	0.57	16.00
24	0100	0.30	16.00	0.47	16.00	0.54	16.00	0.64	16.00
	0700	0.27	16.00	0.42	15.06	0.50	15.06	0.66	15.06
	1300	0.27	15.06	0.44	15.06	0.46	15.06	0.57	15.06
	1900	0.29	15.06	0.44	15.06	0.51	14.22	0.54	15.06
25	0100	0.25	15.06	0.40	15.06	0.44	15.06	0.49	14.22
	0700	0.25	13.47	0.43	14.22	0.47	14.22	0.50	14.22
	1300	0.25	14.22	0.44	15.06	0.48	14.22	0.46	14.22
	1900	0.33	13.47	0.47	14.22	0.48	13.47	0.64	14.22
26	0100	0.26	15.06	0.40	13.47	0.39	13.47	0.54	14.22
	0700	0.23	14.22	0.42	13.47	0.18	3.16	0.50	14.22
	1300	0.29	13.47	0.39	14.22	0.57	13.47	0.60	13.47
	1900	0.31	13.47	0.39	13.47	0.47	13.47	0.60	13.47
27	0100	0.22	13.47	0.32	13.47	0.40	14.22	0.48	8.26
	0700	0.23	14.22	0.30	13.47	0.40	13.47	0.46	8.00
	1300	0.24	12.80	0.36	13.47	0.41	13.47	0.56	5.12
	1900	0.62	4.49	0.71	4.41	0.71	4.34	0.86	4.34
28	0100	0.48	4.41	0.54	4.34	0.54	4.34	0.64	4.06
	0700	1.54	5.82	1.40	5.82	1.55	5.57	1.80	6.09
	1300	0.84	6.09	0.92	5.95	0.97	5.95	1.35	5.95
	1900	0.62	5.82	0.67	5.69	0.68	5.82	0.76	6.09
29	0100	0.51	5.95	0.62	5.82	0.60	6.40	0.68	6.40
	0700	0.35	5.22	0.45	5.82	0.50	5.69	0.50	5.82
	1300	0.30	4.83	0.43	4.74	0.44	13.47	0.44	6.24
	1900	0.27	4.66	0.46	13.47	0.38	6.56	0.50	8.00
30	0100	0.24	4.74	0.37	5.02	0.41	12.80	0.51	4.74
	0700	0.23	4.57	0.36	4.92	0.43	12.80	0.50	4.57
	1300	0.38	4.49	0.51	7.53	0.53	3.56	0.68	3.66
	1900	0.32	7.53	0.43	7.53	0.43	7.76	0.61	7.11
31	0100	0.28	3.71	0.36	11.64	0.38	6.92	0.54	6.92
	0700	0.21	8.00	0.37	7.53	0.38	7.53	0.50	7.53
	1300	0.24	6.40	0.34	6.92	0.38	8.00	0.43	6.74
	1900	0.28	6.92	0.35	8.26	0.36	8.00	0.53	7.31
Mean		0.43	9.26	0.61	9.65	0.62	9.50	0.72	8.42
Std dev		0.25	3.88	0.29	3.27	0.31	3.38	0.28	3.01

* Electronic problems

(Sheet 2 of 2)



PART IV: CURRENT DATA

Current data (Table 4) are collected from a Marsh-McBirney electromagnetic biaxial current meter (Table 1 and Figure 2) and by visually observing the movement of dye on the water surface in the surf and at the seaward end of the pier, as well as 500 m updrift of the pier 12 m offshore.

Since the shoreline orientation is approximately N20W, longshore currents flow either toward 340 deg (i.e. northward) or toward 160 deg (i.e. southward). Similarly, cross-shore currents are either onshore (westward) or offshore (eastward).

All current speeds are given in centimeters per second (cm/sec). Resultant speeds and directions are determined by vector averaging the data.

Table 4: Current Data
May 1989

Alongshore Cross-shore Resultant Time	Pier Measurements						Beach Measurements			Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		(500m Updrift)		Dye 12m offshore (surface)		Location	Speed	Dir
Day	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir	
1 0100-Along Cross Result											
1 0700-Along Cross Result	30 3 31	N on 334	152		61 24 66	N on 318	North	43	N		
1 1300-Along Cross Result											
1 1900-Along Cross Result											
2 0100-Along Cross Result											
2 0700-Along Cross Result	55 28 62	N off 7	152		152 0 152	N 340	South	70	N		
2 1300-Along Cross Result											
2 1900-Along Cross Result											
3 0100-Along Cross Result											
3 0700-Along Cross Result	23 8 25	S on 179	152		16 9 18	S on 191	South	9	N		
3 1300-Along Cross Result											
3 1900-Along Cross Result											
4 0100-Along Cross Result											
4 0700-Along Cross Result	24 7 25	S on 177	165		9 8 12	N off 22	South	2	S		
4 1300-Along Cross Result											
4 1900-Along Cross Result											
5 0100-Along Cross Result											
5 0700-Along Cross Result	44 7 44	N on 331	152		27 0 27	N 340	South	56	N		
5 1300-Along Cross Result											
5 1900-Along Cross Result											

KEY = All speeds in cm/sec
N = Northward, Shore parallel
S = Southward, Shore parallel
on = onshore off = offshore

Table 4: Current Data (Continued)
May 1989

Alongshore Cross-shore Resultant Time	Pier Measurements						Beach Measurements (500m Updrift)			Current Meter	
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)		Dye 12m offshore (surface)		Location	Speed	Dir	Speed	Dir
Day	Speed	Dir	Speed	Dir	Speed	Dir	Location	Speed	Dir	Speed	Dir
6 0100-Along Cross Result											
6 0700-Along Cross Result	16 16 23	N off 25	189		34 17 38	N off 7	South	23	N		
6 1300-Along Cross Result											
6 1900-Along Cross Result											
7 0100-Along Cross Result											
7 0700-Along Cross Result	25 13 28	S on 187	152		20 20 29	S off 115	North	11	S		
7 1300-Along Cross Result											
7 1900-Along Cross Result											
8 0100-Along Cross Result											
8 0700-Along Cross Result	9 16 18	S off 100	140		16 4 16	S off 146	South	6	S		
8 1300-Along Cross Result											
8 1900-Along Cross Result											
9 0100-Along Cross Result											
9 0700-Along Cross Result	13 9 16	N off 15	152		0 12 12		North	18	N		
9 1300-Along Cross Result											
9 1900-Along Cross Result											
10 0100-Along Cross Result											
10 0700-Along Cross Result	23 18 29	N off 17	165		76 46 89	N on 309	South	81	N		
10 1300-Along Cross Result											
10 1900-Along Cross Result											

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
May 1989

Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter		
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
Day										
11 0100-Along Cross Result										
11 0700-Along Cross Result	47 0	S		152	68 10 68	S off 151		40 N		
11 1300-Along Cross Result	47	160					South			
11 1900-Along Cross Result										
12 0100-Along Cross Result										
12 0700-Along Cross Result	16 6 17	S off 141		152	0 12 12		3 S			
12 1300-Along Cross Result							South			
12 1900-Along Cross Result										
13 0100-Along Cross Result										
13 0700-Along Cross Result	23 9 24	S on 182		165	0 18 18		9 N			
13 1300-Along Cross Result							South			
13 1900-Along Cross Result										
14 0100-Along Cross Result										
14 0700-Along Cross Result	8 6 10	N off 15		152	23 5 24	S on 171		8 N		
14 1300-Along Cross Result							South			
14 1900-Along Cross Result										
15 0100-Along Cross Result										
15 0700-Along Cross Result	29 16 33	N on 311		177	14 8 16	N off 9	8 S			
15 1300-Along Cross Result							South			
15 1900-Along Cross Result										

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
May 1989

Alongshore Cross-shore Resultant Time	Pier Measurements						Beach Measurements			Current Meter		
	Dye at (579 m) (surface)		Dye at Mid-Surf Zone (surface) Distance from Baseline (m)				Dye 12m offshore (surface)				Speed	Dir
Day	Speed	Dir	Speed	Dir		Location	Speed	Dir				
16 0100-Along Cross Result												
16 0700-Along Cross Result	3 3 4	S on 205	165	0 29 29	off 70	North	4	S				
16 1300-Along Cross Result												
16 1900-Along Cross Result												
17 0100-Along Cross Result												
17 0700-Along Cross Result	9 2 9	S off 149	140	30 30 43	S on 205	South	29	S				
17 1300-Along Cross Result												
17 1900-Along Cross Result												
18 0100-Along Cross Result												
18 0700-Along Cross Result	47 26 54	S off 131	165	28 35 44	S on 211	North	27	S				
18 1300-Along Cross Result												
18 1900-Along Cross Result												
19 0100-Along Cross Result												
19 0700-Along Cross Result	12 9 15	S on 197	189	12 21 24	S on 220	North	69	S				
19 1300-Along Cross Result												
19 1900-Along Cross Result												
20 0100-Along Cross Result												
20 0700-Along Cross Result	9 0 9	S off 160	146	0 0 0		North	23	S				
20 1300-Along Cross Result												
20 1900-Along Cross Result												

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
May 1989

Alongshore Cross-shore Resultant Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter		
	Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed	Dir
Day											
21 0100-Along Cross Result											
21 0700-Along Cross Result	11 1 11	N on 334		165		12 0 12	N 340		10 N South		
21 1300-Along Cross Result											
21 1900-Along Cross Result											
22 0100-Along Cross Result											
22 0700-Along Cross Result	0 9 9			152		0 2 2			2 S North		
22 1300-Along Cross Result											
22 1900-Along Cross Result											
23 0100-Along Cross Result											
23 0700-Along Cross Result	15 4 16	N off 354		152		14 1 14	N off 346		10 N South		Gage Inoperative
23 1300-Along Cross Result											
23 1900-Along Cross Result											
24 0100-Along Cross Result											
24 0700-Along Cross Result	17 7 19	S off 138		165		15 9 17	S on 191		9 S North		
24 1300-Along Cross Result											
24 1900-Along Cross Result											
25 0100-Along Cross Result											
25 0700-Along Cross Result	24 0 24	N 152 340				5 0 5	N 340		15 N South		
25 1300-Along Cross Result											
25 1900-Along Cross Result											

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Continued)
May 1989

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)			Current Meter	
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface) Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed
26	0100-Along Cross Result									
26	0700-Along Cross Result	14 6 off 15	N off 4		152	23 18 29	N off 17		20 N South	
26	1300-Along Cross Result									
26	1900-Along Cross Result									
27	0100-Along Cross Result									
27	0700-Along Cross Result	8 14 off 16	N off 39		165	17 3 17	N off 349		29 N South	
27	1300-Along Cross Result									
27	1900-Along Cross Result									
28	0100-Along Cross Result									
28	0700-Along Cross Result	32 8 on 33	S on 174		201	47 7 off 47	S off 151		134 S North	Gage Inoperative
28	1300-Along Cross Result									
28	1900-Along Cross Result									
29	0100-Along Cross Result									
29	0700-Along Cross Result	6 9 on 11	N on 284		165	11 0 11	N off 340		7 S South	
29	1300-Along Cross Result									
29	1900-Along Cross Result									
30	0100-Along Cross Result									
30	0700-Along Cross Result	16 12 off 20	N off 17		177	25 5 off 26	N off 351		34 N South	
30	1300-Along Cross Result									
30	1900-Along Cross Result									

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

Table 4: Current Data (Concluded)
May 1989

Day	Time	Pier Measurements				Beach Measurements (500m Updrift)				Current Meter	
		Dye at (579 m) (surface)	Speed	Dir	Dye at Mid-Surf Zone (surface)	Distance from Baseline (m)	Speed	Dir	Dye 12m offshore (surface)	Location	Speed
31	0100-Along Cross Result										
31	0700-Along Cross Result	10 21 23		N off 43	177		12 7 14	N off 11		62	N
31	1300-Along Cross Result										
31	1900-Along Cross Result										

KEY = All speeds in cm/sec
 N = Northward, Shore parallel
 S = Southward, Shore parallel
 on = onshore off = offshore

PART V: SUPPLEMENTAL OBSERVATIONS

Visual wave direction measurements (Table 5) of both the primary wave train (i.e. that having the larger wave heights) and the secondary wave train (which must be clearly distinguishable as a wave train separate from the primary waves but not surface chop or capillary waves) are taken daily at the seaward end of the pier. The direction of the primary wave train just north of the seaward end of the pier is also determined using a Raytheon Marine Pathfinder radar and measuring the alignment of the wave crests at approximately the same location as the visual measurements. The pier axis (considered perpendicular to the beach at the FRF) is orientated 70 deg east of true north; consequently, wave angles greater than 70 deg indicate that the waves were coming from the south side of the pier.

The width of the surf zone (seawardmost breaker position to shoreline) is determined from the pier deck.

Measurements of surface water temperature, density, and visibility are also taken daily at the seaward end of the pier. A jar along with a thermometer is lowered about 0.3 m into the water and allowed to remain for at least one minute. The jar is removed, the temperature read, and a hydrometer is used to determine the density. A Secchi disc is used to determine the surface visibility.

Table 5: Supplemental Observations

May 1989

Day	Time	Wave Approach		Radar Wave Angle deg from True N	Width of Surf Zone, m	Water Characteristics at Pier End		
		Primary	Secondary			Temp., C	Density g/cc	Secchi Vis., m
1	0708	100			17	15.6	1.0230	3.4
2	0707	100		90	21	13.4	1.0242	2.4
3	0805	30			9	13.0	1.0246	3.7
4	0908	90		75	9	14.7	1.0220	3.0
5	0729	130		95	8	14.8	1.0222	1.5
6	0655	95			30	13.9	1.0250	2.1
7	0835	80	10		12	12.5	1.0256	2.4
8	0709	95			6	11.7	1.0254	2.7
9	0708	110			9	13.3	1.0236	3.7
10	0709	120		90	34	13.4	1.0244	2.7
11	0648	20	95	35	18	13.6	1.0240	3.4
12	0718	105	35		14	14.7	1.0200	2.1
13	0659	115	35		6	15.5	1.0200	3.0
14	0824	45	100	65	20	15.0	1.0220	3.0
15	0736	110		60	21	14.5	1.0224	3.0
16	0716	115			9	15.0	1.0224	4.0
17	0720	15		50	6	16.7	1.0200	3.0
18	0705	20	50	50	24	16.6	1.0176	2.1
19	0716	30		70	110	18.3	1.0172	1.2
20	0847	50		85	35	17.7	1.0174	0.9
21	0927	70		70	23	20.8	1.0184	0.9
22	0702	35	80	45	12	17.0	1.0206	3.0
23	0720	100		90	2	16.7	1.0218	3.0
24	0755	140			3	14.6	1.0238	3.7
25	0854	none visible			6	18.2	1.0220	4.0
26	0721	120		60	8	15.6	1.0236	3.0
27	0811	115			11	15.0	1.0244	3.4
28	0811	15		25	213	18.3	1.0196	2.1
29	0748	35	100	50	12	18.4	1.0184	3.7
30	0728	110	85		20	18.1	1.0224	4.6
31	0810	125	80		13	14.5	1.0234	3.7

PART VI: WATER LEVELS

Since 1978, the National Oceanic and Atmospheric Administration (NOAA)/National Ocean Service (NOS) has operated a primary tide station (No. 865-1370) at the seaward end of the FRF pier. A Leupold-Stevens digital recording float-type tide gage is used to collect instantaneous water level data every 6 minutes throughout the month.

The variation in water level during the month is shown in Figure 4 along with a list of mean and extreme values. This presentation is useful in identifying effects of both meteorological and astronomical forces on the open coast water level.

Table 6 contains the time at the center of each 12.42-hr tidal cycle and the range, high, low, and mean water levels during each tidal cycle.

FRF Tide Heights

May 1989

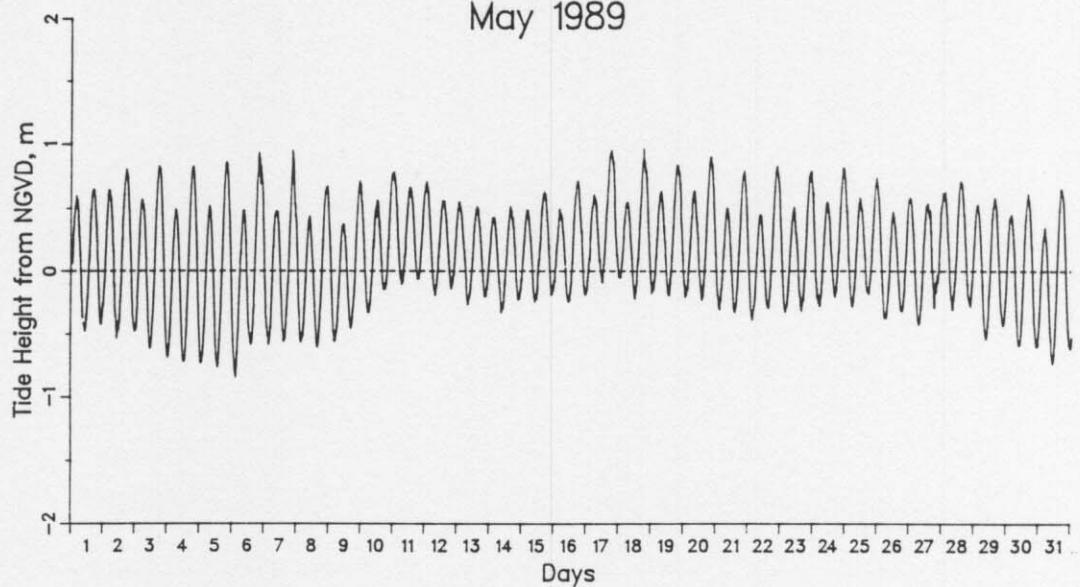


Figure 4. Water Level Time History

Monthly Water Levels, m NGVD

Extreme Low = -0.84 on day 6 at 212 EST
Extreme High = 0.97 on day 18 at 1742 EST
Monthly Mean = 0.14
Mean Low = -0.38
Mean High = 0.64
Mean Range = 1.01

Table 6: Water Levels, m NGVD

		May 1989			
Mid-Cycle Day	Time	Low	High	Mean	Range
1	612	-0.48	0.60	0.07	1.07
1	1837	-0.42	0.65	0.14	1.07
2	703	-0.53	0.65	0.07	1.17
2	1928	-0.48	0.80	0.17	1.28
3	753	-0.61	0.57	0.01	1.18
3	2018	-0.68	0.83	0.10	1.51
4	843	-0.72	0.49	-0.11	1.21
4	2109	-0.73	0.82	0.06	1.55
5	934	-0.76	0.52	-0.12	1.28
5	2159	-0.84	0.86	0.05	1.70
6	1024	-0.58	0.48	-0.08	1.06
6	2249	-0.58	0.93	0.19	1.51
7	1115	-0.56	0.48	-0.01	1.04
7	2340	-0.56	0.95	0.12	1.51
8	1205	-0.60	0.43	-0.09	1.04
9	30	-0.55	0.67	0.06	1.23
9	1255	-0.45	0.37	-0.03	0.83
10	121	-0.33	0.71	0.18	1.04
10	1346	-0.15	0.56	0.17	0.71
11	211	-0.10	0.78	0.35	0.89
11	1436	-0.06	0.66	0.30	0.73
12	301	-0.19	0.71	0.28	0.90
12	1527	-0.14	0.56	0.22	0.70
13	352	-0.27	0.55	0.17	0.81
13	1617	-0.20	0.51	0.16	0.72
14	442	-0.33	0.43	0.08	0.76
14	1707	-0.23	0.52	0.14	0.74
15	532	-0.25	0.49	0.13	0.73
15	1758	-0.19	0.63	0.23	0.82
16	623	-0.24	0.49	0.12	0.74
16	1848	-0.19	0.72	0.26	0.91
17	713	-0.09	0.61	0.26	0.70
17	1938	-0.05	0.95	0.46	1.00
18	804	-0.22	0.55	0.19	0.77
18	2029	-0.18	0.97	0.37	1.15
19	854	-0.19	0.64	0.22	0.83
19	2119	-0.21	0.84	0.33	1.05
20	944	-0.23	0.63	0.21	0.86
20	2210	-0.30	0.90	0.31	1.21
21	1035	-0.33	0.50	0.10	0.83
21	2300	-0.39	0.80	0.20	1.18
22	1125	-0.29	0.45	0.09	0.75
22	2350	-0.33	0.83	0.24	1.16
23	1216	-0.32	0.51	0.10	0.83
24	41	-0.28	0.79	0.23	1.07
24	1306	-0.20	0.55	0.18	0.75
25	131	-0.29	0.81	0.26	1.10
25	1356	-0.18	0.58	0.19	0.77
26	222	-0.37	0.74	0.16	1.11
26	1447	-0.32	0.47	0.06	0.79
27	312	-0.42	0.58	0.09	1.00
27	1537	-0.29	0.53	0.17	0.82
28	402	-0.30	0.63	0.20	0.94
28	1628	-0.28	0.72	0.22	0.99
29	453	-0.53	0.53	0.01	1.06
29	1718	-0.43	0.58	0.07	1.01
30	543	-0.59	0.45	-0.06	1.03
30	1808	-0.60	0.62	0.01	1.22
31	634	-0.73	0.35	-0.19	1.08
31	1859	-0.61	0.66	0.08	1.27

PART VII: NEARSHORE PROFILES

A. Nearshore Profiles. In order to document profile response away from the pier, surveys of four profile lines extending 900 to 1,000 m from shore and located 489 and 581 m north and 517 and 608 m south of the FRF pier are conducted bi-weekly, after storms, and during more complete bathymetric surveys.

These profiles are obtained using the CRAB-Zeiss surveying system; a Zeiss Elta-2 first-order, self-recording electronic theodolite distance meter in combination with the Coastal Research Amphibious Buggy (CRAB), a 10.7 m high, self-powered, mobile tripod on wheels.

Figure 5 shows the last survey in April and the two surveys in May on profile line 188, located 517 m south of the pier. The only significant change was the development of a large berm and trough (80 - 180 m) early in May and their subsequent removal later in the month.

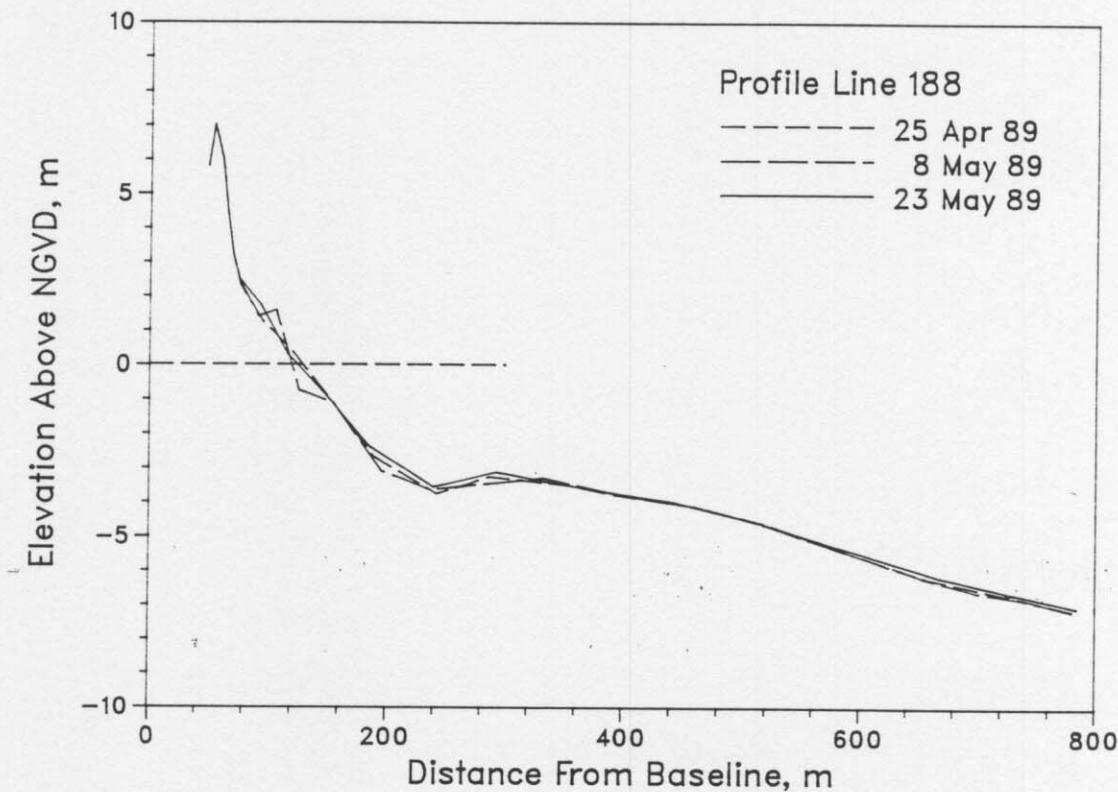


Figure 5. Monthly CRAB profiles on profile 188 - 517 m south of pier.

The profile envelope (Figure 6) reflects the maximum changes that occurred on the profile during 1989. The largest change (80 - 120 m) is a result of the berm's development.

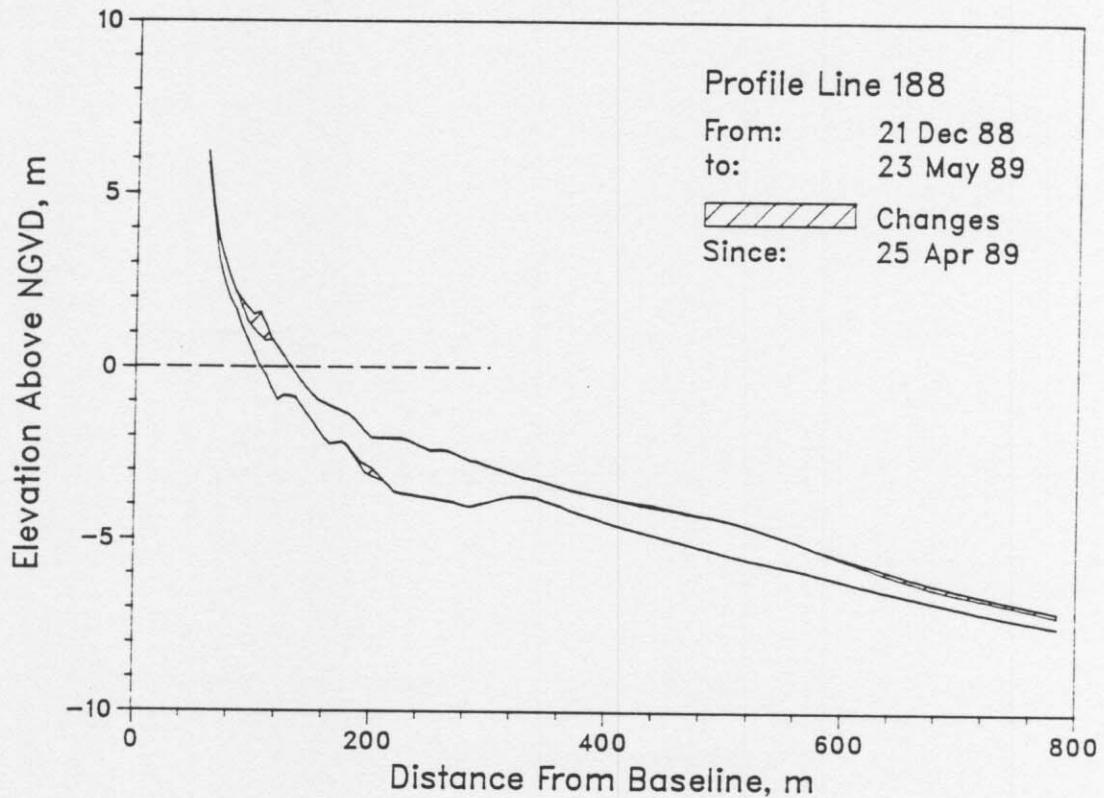


Figure 6. CRAB profile envelope - profile 188.

B. Bathymetry. Figure 7 includes a two- and three-dimensional contour map and a change plot derived from the bathymetric survey on 24 May. Wide contour lines on the change diagram represent eroded areas; thin lines indicate deposition.

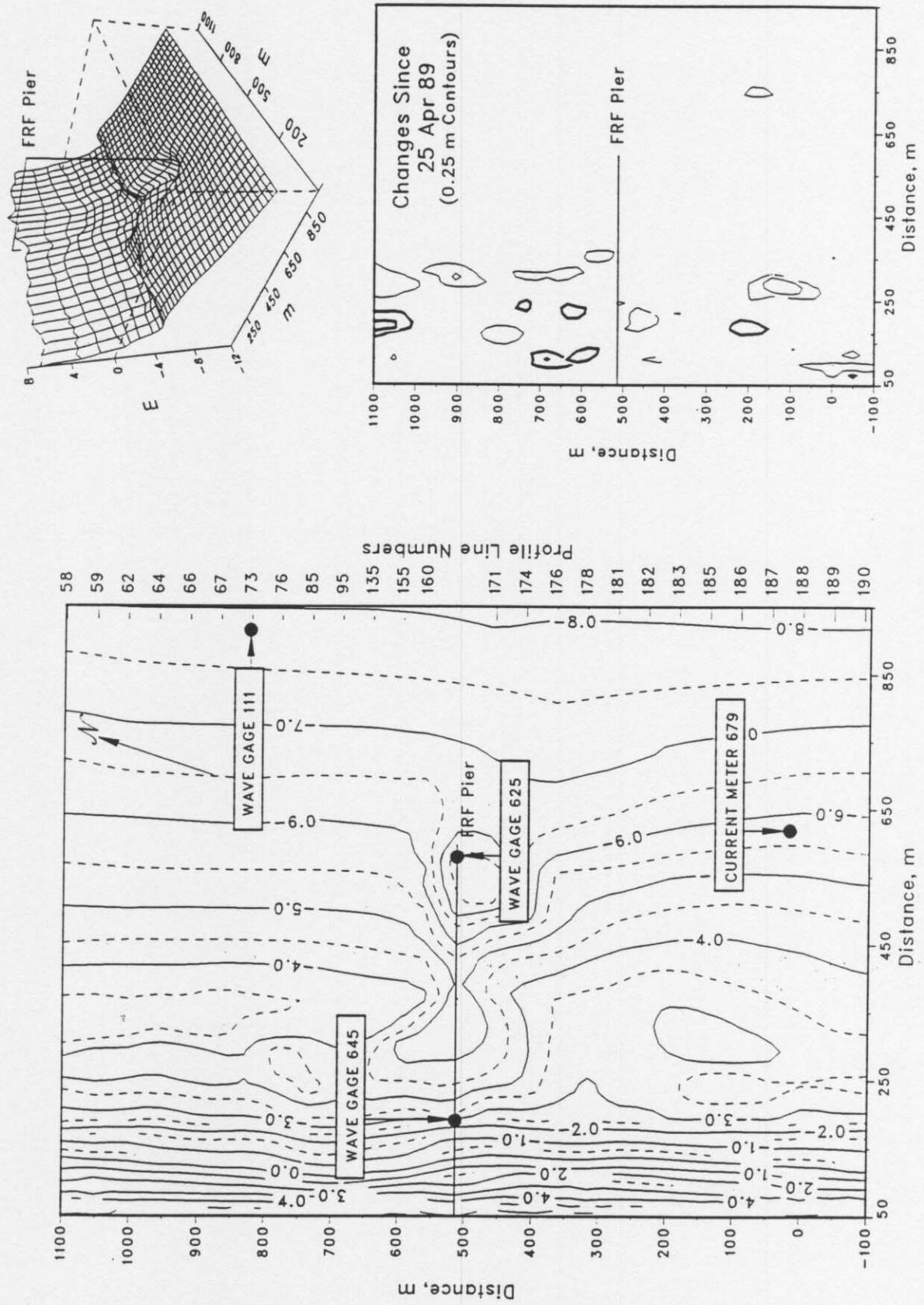


Figure 7. FRF bathymetry 24 May 89 (depths relative to NGVD)

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